

## CLAIMS

What is claimed is:

- 1 1. A method of automatically configuring a network device, the method comprising the  
2 computer-implemented steps of:  
3 receiving a request from the network device to provide configuration information;  
4 retrieving a template describing a device configuration, wherein the template  
5 comprises zero or more parameters that may receive values specific to a  
6 particular device;  
7 retrieving zero or more values of parameters specific to the device;  
8 creating and storing a device-specific instance of the configuration information based  
9 on the template and the values of parameters and conforming to an Extensible  
10 Markup Language Document Type Definition (XML DTD), comprising one  
11 or more XML tags that delimit the configuration information.
  
- 1 2. A method as recited in Claim 1, further comprising the steps of:  
2 testing the configuration information to determine whether it is well-formed with  
3 respect to the XML DTD;  
4  
5 providing the configuration information to the network device.
  
- 1 3. A method as recited in Claim 1, further comprising the steps of:  
2 testing the configuration information to determine whether it is well-formed with  
3 respect to the XML DTD;  
4  
5 providing the configuration information to the network device over a reliable  
6 transport protocol that assures that the entire configuration information is  
7 received at the network device.

1    4. A method as recited in Claim 1, further comprising the steps of:  
2        at the network device,  
3                syntax checking the configuration information to determine whether  
4                configuration commands therein conform to a command language that is  
5                understood by the network device;  
6                applying the configuration information to the network device.

1    5. A method as recited in Claim 1, further comprising the steps of:  
2        at the network device,  
3                syntax checking the configuration information to determine whether  
4                configuration commands therein conform to a command language that is  
5                understood by the network device;  
6                applying the configuration information to the network device;  
7                when a syntax error is detected during the syntax checking step, publishing an  
8                event that reports the syntax error using an event service.

1    6. A method as recited in Claim 1, further comprising the steps of:  
2        providing the configuration information to a plurality of network devices;  
3        at one of the network devices, syntax checking the configuration information to  
4                determine whether configuration commands therein conform to a command  
5                language that is understood by the network device;  
6        upon successful syntax checking, generating an event to an event service to which the  
7                plurality of network devices subscribe, wherein the event announces that the  
8                configuration commands conform to correct syntax;  
9        in response to receiving the event, applying the configuration information to the  
10                network devices concurrently.

1    7. A method as recited in Claim 1, further comprising the steps of:  
2        providing the configuration information to a plurality of network devices;

3           upon successfully receiving the configuration information at one of the network  
4           devices, generating an event to an event service to which the plurality of  
5           network devices subscribe;  
6           in response to receiving the event, applying the configuration information to the  
7           network devices concurrently.

1       8. A method as recited in Claim 1, further comprising the steps of:  
2           applying the configuration information to the network device;  
3           receiving a user request to cancel application of the configuration information;  
4           restoring the network device to its state prior to application of the configuration  
5           information.

1       9. A method as recited in Claim 1, wherein the step of receiving a request from the  
2           network device to provide configuration information comprises the step of receiving  
3           an HTTP request that identifies a configuration service that can provide the  
4           configuration information and that includes a unique identifier of the network device.

1       10. A method as recited in Claim 1, wherein the step of receiving a request from the  
2           network device to provide configuration information comprises the step of receiving  
3           an HTTP request that identifies an Active Server Page of a configuration service that  
4           can provide the configuration information and that includes a unique identifier of the  
5           network device.

1       11. A method as recited in Claim 1, wherein the step of receiving a request from the  
2           network device to provide configuration information comprises the step of receiving  
3           an HTTP request that identifies a Java® Servlet of a configuration service that can  
4           provide the configuration information and that includes a unique identifier of the  
5           network device.

1       12. A method as recited in Claim 1, wherein the step of receiving a template comprises  
2           the step of retrieving a template describing the configuration information, wherein the  
3           template comprises zero or more parameters that may receive values specific to a  
4           particular device, and wherein the step of receiving zero or more values of parameters  
5           specific to the device comprises the step of retrieving a container object associated  
6           with the network device from the directory and obtaining the values of parameters  
7           from directory objects contained within the container object.

1       13. A method as recited in Claim 1, wherein the step of receiving a template comprises  
2           the steps of:  
3              retrieving a reference to a template describing the configuration information from a  
4                  directory service;  
5              retrieving the template from a configuration server based on the received reference,  
6                  wherein the template comprises zero or more parameters that may receive  
7                  values specific to a particular device, and wherein the step of receiving zero or  
8                  more values of parameters specific to the device comprises the step of  
9                  retrieving a container object associated with the network device from the  
10                 directory and obtaining the values of parameters from directory objects  
11                 contained within the container object.

1       14. A method as recited in Claim 5, wherein the step of syntax checking comprises  
2           parsing one or more configuration commands within the configuration information  
3           using a parser of an operating system that is executed by the network device.

1       15. The method as recited in Claim 1, further comprising the steps of:  
2           determining that a partial configuration should be sent to one or more network  
3           devices;

4 based on the template and the zero or more values of parameters specific to the  
5 device, creating and storing a device-specific instance of the partial  
6 configuration based on the template and the values of parameters and  
7 conforming to an Extensible Markup Language Document Type Definition  
8 (XML DTD), comprising one or more XML tags that delimit the partial  
9 configuration;  
10 publishing the partial configuration to an event service that is communicatively  
11 coupled to the network devices.

1 16. The method as recited in Claim 1, further comprising the steps of:  
2 determining that a partial configuration should be sent to one or more network  
3 devices;  
4 based on the template and the zero or more values of parameters specific to the  
5 device, creating and storing a device-specific instance of the partial  
6 configuration based on the template and the values of parameters and  
7 conforming to an Extensible Markup Language Document Type Definition  
8 (XML DTD), comprising one or more XML tags that delimit the partial  
9 configuration;  
10 publishing a partial configuration trigger event to an event service that is  
11 communicatively coupled to the network devices; providing the partial  
12 configuration to one or more network devices in response to requests  
13 therefrom that are received in response to the trigger event.

1 17. A method of automatically configuring a network device, the method comprising the  
2 computer-implemented steps of:  
3 generating a request to provide configuration information;

4 receiving a set of configuration information conforming to an Extensible Markup  
5 Language Document Type Definition (XML DTD), the configuration  
6 information comprising one or more XML tags that delimit the configuration  
7 information, based on a template describing a device configuration that is  
8 instantiated with zero or more parameter values that are specific to the  
9 network device;  
10 syntax checking the configuration information to determine whether configuration  
11 commands therein conform to a command language that is understood by the  
12 network device;  
13 applying the configuration information to the network device.

1 18. A method as recited in Claim 17, wherein the set of configuration information is  
2 received concurrently at a plurality of network devices, and further comprising the  
3 steps of:  
4 at one of the network devices, syntax checking the configuration information to  
5 determine whether configuration commands therein conform to a command  
6 language that is understood by the network device;  
7 upon successful syntax checking, generating a status event to an event service to  
8 which the plurality of network devices subscribe, wherein the status event  
9 announces that the configuration commands conform to correct syntax;  
10 in response to receiving a “write” event, applying the configuration information to the  
11 network device.

1 19. A method as recited in Claim 17, wherein the step of generating a request to provide  
2 configuration information comprises the step of generating an HTTP request that  
3 identifies a configuration service that can provide the configuration information and  
4 that includes a unique identifier of the network device.

1    20. A method as recited in Claim 17, wherein the step of generating a request to provide  
2    configuration information comprises the step of generating an HTTP request that  
3    identifies an Active Server Page of a configuration service that can provide the  
4    configuration information and that includes a unique identifier of the network device.

1    21. A method as recited in Claim 17, wherein the step of generating a request to provide  
2    configuration information comprises the step of generating an HTTP request that  
3    identifies a Java® Servlet of a configuration service that can provide the configuration  
4    information and that includes a unique identifier of the network device.

1    22. A method as recited in Claim 17, wherein the step of receiving a set of configuration  
2    information comprises the steps of, at a configuration server, receiving a template  
3    describing the device configuration from a directory service, wherein the template  
4    comprises zero or more parameters that may receive values specific to a particular  
5    device, and wherein the step of receiving zero or more values of parameters specific  
6    to the device comprises the step of retrieving a container object associated with the  
7    network device from the directory and obtaining the values of parameters from  
8    directory objects contained within the container object.

1    23. A method as recited in Claim 17, wherein the step of syntax checking comprises  
2    applying the configuration commands to a parser of an operating system that is  
3    executed by the network device.

1    24. An apparatus for automatically configuring a network device, comprising:  
2         a configuration service configured for carrying out the steps of:  
3             receiving, from a configuration agent executed by the network device, a  
4             request to provide configuration information;

5           retrieving a template describing a device configuration, wherein the template  
6           comprises zero or more parameters that may be resolved into values  
7           specific to a particular device;  
8           retrieving zero or more values of parameters specific to the device;  
9           creating and storing a device-specific instance of the configuration  
10          information based on the template and the values of parameters and  
11          conforming to an Extensible Markup Language Document Type  
12          Definition (XML DTD), comprising one or more XML tags that  
13          delimit the configuration information.

1   25. An apparatus as recited in Claim 24, further comprising:  
2       one or more configuration templates stored in a directory service, wherein each of the  
3       configuration templates comprises an object in the directory service that  
4       describes the device configuration, and wherein the template comprises zero  
5       or more parameters that may receive values specific to a particular device;  
6       one or more container objects stored in the directory service and associated with the  
7       network device, each of the container objects comprising values for the zero or  
8       more parameters in one of the configuration templates that corresponds to the  
9       network device.

1   26. A computer-readable medium carrying one or more sequences of instructions for  
2       automatically configuring a network device, which instructions, when executed by  
3       one or more processors, cause the one or more processors to carry out the steps of:  
4       receiving a request from the network device to provide configuration information;  
5       retrieving a template describing a device configuration, wherein the template  
6       comprises zero or more parameters that may be resolved into values specific to  
7       a particular device;  
8       retrieving zero or more values of parameters specific to the device;

9           creating and storing a device-specific instance of the configuration information based  
10          on the template and the values of parameters and conforming to an Extensible  
11          Markup Language Document Type Definition (XML DTD), comprising one  
12          or more XML tags that delimit the configuration information.

1   27. An apparatus for automatically configuring a network device, comprising:  
2       means for receiving a request from the network device to provide configuration  
3       information;  
4       means for retrieving a template describing a device configuration, wherein the  
5       template comprises zero or more parameters that may be resolved into values  
6       specific to a particular device;  
7       means for retrieving zero or more values of parameters specific to the device;  
8       means for creating and storing a device-specific instance of the configuration  
9       information based on the template and the values of parameters and  
10      conforming to an Extensible Markup Language Document Type Definition  
11      (XML DTD), comprising one or more XML tags that delimit the configuration  
12      information.

1   28. An apparatus for automatically configuring a network device, comprising:  
2       a network interface that is coupled to the data network for receiving one or more  
3       packet flows therefrom;  
4       a processor;  
5       one or more stored sequences of instructions which, when executed by the processor,  
6       cause the processor to carry out the steps of:  
7       generating a request to provide configuration information;  
8       retrieving a set of configuration information conforming to an Extensible Markup  
9       Language Document Type Definition (XML DTD), the configuration  
10      information comprising one or more XML tags that delimit the configuration  
11      information, based on a template describing a device configuration that is  
12      instantiated with zero or more parameter values that are specific to the  
13      network device;

14       syntax checking the configuration information to determine whether configuration  
15               commands therein conform to a command language that is understood by the  
16               network device;  
17       applying the configuration information to the network device.

1       29. An apparatus as recited in Claim 28, wherein the step of syntax checking comprises  
2               the steps of determining whether the set of configuration information is well formed  
3               with respect to XML; determining whether the set of configuration information  
4               conforms to correct XML syntax; and determining whether the configuration  
5               commands conform to correct command language syntax.

1       30. An apparatus for automatically configuring a network device, comprising:  
2               a configuration agent executed by the network device and configured for carrying out  
3               the steps of:  
4                       generating a request to provide configuration information;  
5                       receiving a device-specific instance of configuration information based on a  
6                       template describing a device configuration, wherein the template  
7                       comprises zero or more parameters that may be resolved into values  
8                       specific to a particular device, and based on zero or more values of  
9                       parameters specific to the device that are received from a repository,  
10                      and wherein the template conforms to an Extensible Markup Language  
11                      Document Type Definition (XML DTD), comprising one or more  
12                      XML tags that delimit the configuration information;  
13                      applying the configuration information to the network device to result in re-  
14                      configuring the network device in accordance with the template.

1       31. An apparatus as recited in Claim 30, further comprising:  
2               one or more configuration templates stored in a directory service, wherein each of the  
3                       configuration templates comprises an object in the directory service that  
4                       describes the device configuration, and wherein the template comprises zero  
5                       or more parameters that may receive values specific to a particular device;

6       one or more container objects stored in the directory service and associated with the  
7            network device, each of the container objects comprising values for the zero or  
8            more parameters in one of the configuration templates that corresponds to the  
9            network device.

1       32. A method of automatically configuring a computer program application that uses  
2            information about network devices or topology in order to operate in a network  
3            environment, comprising the steps of:

4            receiving a request for network topology information from the application;  
5            retrieving a template of network topology information from a repository;  
6            resolving elements of the topology into application-specific values, resulting in  
7            creating and storing resolved topology information;  
8            providing the resolved configuration information to a configuration agent within the  
9            application that is configured to re-configure the application to operate with  
10           the then-current network configuration.

1       33. A method as recited in Claim 32, wherein resolving elements of the topology includes  
2            the step of carrying out application-specific syntax checking of elements of the  
3            template.